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Comparing lateral or supine positions without using traction table in the treatment of per-trochanteric femur fractures

Operation positions of intertrochanteric femur fractures

Esra Demirel[1], Kadri Yıldız[2]
[1]Orthopedia and Traumatology Clinic, Regional Research and Training Hospital, Erzurum
[2]Department of Orthopaedics and Traumatology, Kafkas University, School of Medicine, Kars, Turkey

Abstract
Aim: This study aims to compare the duration of operation, quality of reduction, and complications in cases of per-trochanteric femur fractures fixed by proximal femoral anti-rotational nail at the lateral and supine positions without using a traction table.
Material and Methods: A total of 160 patients between January 2008 and December 2014 (61 females, 99 males; mean age: 75.9) were presented. The proximal femoral anti-rotational nail was performed at the lateral and supine positions in 89 and 71 patients, ordinarily. All patients have evaluated for Evans and AO (American Orthopedics Classification) fracture classifications, duration of operations, postoperative complications, tip-apex diameter, collodiaphyseal angles, axial reduction range, and position of the helical blade according to Herman's criteria.
Results: The mean duration of operation in the lateral and supine position groups were 60.7±20.2 and 56.4±18.5 minutes, ordinarily. The mean tip-apex distance was 25.91 mm in the lateral group and 26.11 mm in the supine group. The mean collodiaphyseal angle was 135.55° in the lateral group and 136.92° in the supine group. The mean axial reduction distance was 4.01 mm in the lateral group and 3.84 mm in the supine group. Helical blade placing was within the safe zone in 59.6% of the lateral group and 49.3% of the supine group according to Herman's criteria.
Discussion: There was no statistically significant difference in the results and complications in comparing both positions. When the traction table is not available, lateral and supine positions can be used to fix the per-trochanteric femur fractures.

Keywords
Per-trochanteric/Intertrochanteric; Femur fractures; Supine position; Lateral position; Traction table; Proximal; Femoral; Anti-rotational nail (PFN-A)

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Corresponding Author: Kadri YILDIZ, Assoc. Prof., Kafkas University Medical School Orthopeadia and Traumatology Department, 36000, Kars, Turkey.
E-mail: drkadri1980@hotmail.com P: +90 538 545 0559 / +90 474 225 2106-7625
Corresponding Author ORCID ID: https://orcid.org/0000-0002-8164-7687

Introduction

In the literature, there are few studies about the Proximal Femoral Nail-A (PFN-A) in the supine position without using a traction table [1-4]. On the other hand, Ozturk et al compared results of both cephalomedullary nailing (CMN) and proximal femur locking plates (PFLP). They found satisfactory results in the surgery time, peroperative transfusion need, length of hospital stay in the postoperative period, mechanical failure and reoperation rates [5].

This study aims to compare the results of these two methods, while the traction table was not used in both techniques. For both methods, duration of operations, radiological measurements (preoperative and postoperative), and complications were evaluated. Also, we aim to find answers to the question of the superiority of these two techniques over each other according to clinical and radiological outcomes, secondary.

Material and Methods

Patients, screened for per-trochanteric femur fractures, who applied to our emergency service between January 2008 and December 2014 were included in a cross-sectional study. The inclusion criteria for study groups were the presence of unstable per-trochanteric femur fractures, PFN-A application in the lateral and supine position without using a traction table, availability of proper antero-posterior and lateral postoperative X-rays, availability of follow-up X-rays obtained at least in the first post-operative year. Patients with metastatic femur fractures, open fractures, additional fractures, patients with inadequate pre-operative and post-operative X-rays, and patients with insufficient archive records were excluded from the study. Operations were performed by 6 different surgeons on a radiolucent operation table. The classifications were made according to AO and Evans fracture classifications (available at:https://surgeryreference.aofoundation.org/orthopedic-trauma/adulttrauma/proximal-femur) [6]. In the radiological evaluation, the collo-diaphyseal angle, tip-apex diameters, reduction range, and localization of the helical blade placing according to Herman criteria were used [7,8].

The duration of operations and complications were assessed statistically. Patients were permitted to walk up to 4 to 8 weeks according to their radiological control X-ray and clinical pain scores. Control visits were made in the third and sixth months of a clinical trial. X-ray views were obtained for comparing preoperative radiological findings using the Picture Archiving and Communication System (PACS) of our hospital. Also, epicrises of the discharged patients and operation reports were obtained from archive files. The radiographic findings of all the subjects were evaluated by a senior orthopedist. Prophylactic parenteral cefazolin sodium (1000 mg) was given to all patients pre- and postoperatively. Lateral and Supine positions are shown in Figure 1.

Lateral position: Two methods were used to obtain lateral X-ray: firstly, the image was obtained by flexion, abduction, and external rotation positions of the hip with fluoroscopy at U shape. Secondly, the hip was not positioned and the image was obtained by keeping the fluoroscopy at C shape with approximately 30°-40° toward cranial (to see the intertrochanteric region by preventing superposition of PFN guide at following stages) and approximately 20° toward dorsal (to take the proper lateral image by considering femoral anteversion). In the proper position, the nail was extended from the guide and sent to a helical blade, and then the distal locking screw was applied.

Supine position: After anesthetic induction, the patient was positioned in the supine position. After sterilization, an elevation material for the hip of about 10 cm (pillow or roll wrap) was placed under the fractured hip without causing excess from the table laterally. Before the sterilization procedure, lateral and antero-posterior X-ray imaging by C-armed fluoroscopy was controlled. Antero-posterior and lateral images were obtained when the fluoroscopy was in C and U positions, ordinally.

STATA® 12 Statistical Software (Texas, USA) program was used for statistical analysis. A Chi-square test was used for binary comparison analysis of categorical databases. The T-test (two groups mean-comparison test) was used in comparison with normally distributed parameters to measure significance. The independent samples t-test was employed, which compares the difference in the means from the two groups with a specific value of zero in the study. The significance was assessed at the level of $p<0.05$. Corresponding two-tailed p-values were calculated to be greater than 0.05 or less. Thus, it can be investigated whether the mean difference in lateral and supine positions is different from 0. Parameters normally distributing as well as descriptive statistical methods (mean values, standard deviation, median, frequency, rate, 95% confidence interval) were calculated for the assessment of databases in the study.

Results

Considering the inclusion and exclusion criteria, 160 patients eligible for the study were identified. A total of 160 patients [61 (38.1%) females and 99 (61.9%) males] were evaluated for this study. This study included 160 patients with per-trochanteric femur fractures, of whom 89 (56%) were operated in the lateral position and 71 patients (44%) were operated in the supine position. The mean age of the study group was 75.9±12.3 years. Twenty-six patients (78.8%) were operated under spinal anesthesia and 34 (21.2%) were operated under general anesthesia. When comparing supine (n=71) and lateral (n==89) group databases, the F/M ratio in the gender distribution was 25/46 and 36/53, respectively, 0.498 ($p\geq0.05$).

As for the etiology, it was a fall in 144 patients (90%), falling down from a height in 9 patients (5.6%), and a traffic accident in 7 patients (4.4%). The types of Evans fractures were evaluated as follows: 14 patients (8.8%) were Type 1, 23 patients (14.4%) were Type 2, 31 patients (19.4%) were Type 3, 34 patients (21.3%) were Type 4, 40 patients (25.0%) were Type 5 and a reverse oblique fracture was present in 18 patients (11.3%).

The mean operation day after admission to the hospital was 2.25±1.72 days. The mean duration of operation was 60.90±23.03 minutes. Although the duration of operation was longer in the lateral position group, no statistically significant difference was presented between the two ($p\geq0.05$). The mean hospital stay was 6.5±3.49 days.

The mean PFNA sizes were 232.4±7.3 mm in the lateral position group, and 231.7±6.4 mm; the mean sizes of lag screw were

Figure 1. a) supine position anteroposterior view, b) supine position lateral view, c) lateral position anteroposterior view, d) lateral position lateral view.

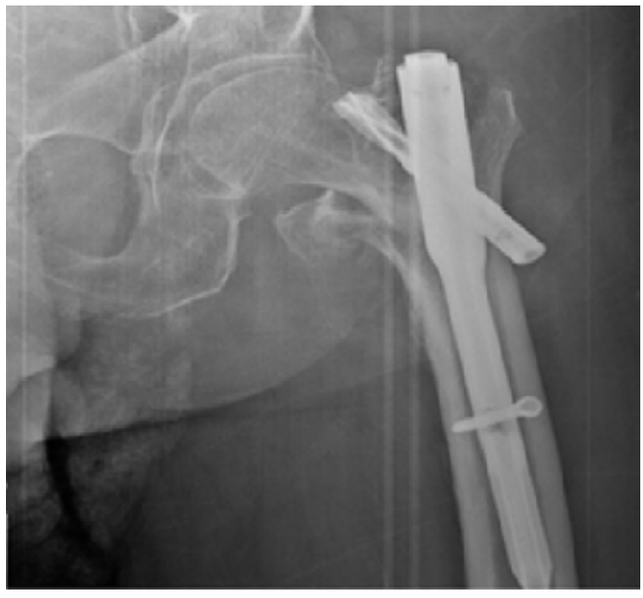

Figure 2. Cut-out example X-ray (superolateral migration)

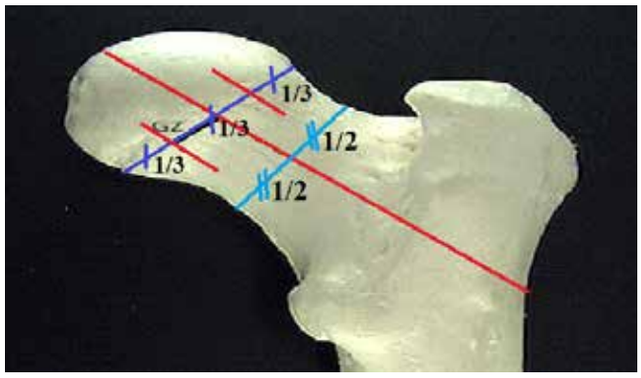

Figure 3. Safe-Zon (SZ) which is optimal localization of lag screw according to Herman

99.8±2.3 mm in the lateral position group, and 98.9±3.7 mm (p=0.467). There was no statistically significant difference in mean tip-apex distance (TAD) and collo-diaphyseal angle (CDA) (p≥0.05). The reduction range measured on lateral X-rays of the patients informed us about the quality of the reduction. There was no statistically significant difference in the mean reduction range between the two groups (p≥0.05). In our patients operated with PFN-A, stability was assessed as a criterion for whether helical blade placing was in the safe zone or not. Helical blade placing was in the safe zone in 59 of 89 (66.3%) patients in the lateral group and in 35 of 71 (49.3%) patients in the supine group. Although helical blade placing appeared in a stable position in most cases in the lateral group, no statistically significant difference was attained between the two groups (p≥0.05).

On the fracture side, the right/left ratio was 40/31 in the supine group and 48/41 in the lateral group, 0.761 (p≥0.05). The ratio of stable/unstable fractures was 28/43 in the supine group and 39/50 in the lateral, 0.577 (p≥0.05). The mean duration of operation was 56.4 min in the supine group and 60.7 min in the lateral group, (p=0.271; p≥0.05). The mean in TAD was 26.1(±13.8) mm in the supine group and 25.9 (±11.6) in the lateral group, (0.263; p≥0.05). The mean reduction was 3.84 mm in the supine group and 4.01 in the lateral group, (0.375; p≥0.05). The mean CDA was 136.9° (±6.4) in the supine group and 135.6° in the lateral group (±7.6), (0.301; p≥0.05). The mean value of the helical blade in the safe zone was 35 (49.3%) in the supine group and 59 (66.3%) in the lateral group, (0.030; p≥0.05). The number of general complications was 19 (26.7%) in the supine group and 17 (19.1%) in the lateral group, (0.498; p≥0.05). The number of cut-out was 3 (4.2%) in the supine group and 4 (%4.5) in the lateral group, 0.293 (p≥0.05). The number of migrations was 2 (2.9%) in the supine group and 1 (%1.1) in the lateral group, 0.305 (p≥0.05). The number of varus was 4 (5.6%) in the supine group and 6 (6.7%) in the lateral group, 0.479 (p≥0.05). The distribution of complications according to operation position was 10 of the general complications (avascular necrosis, heterotopic ossification, wound infection) in the supine group, 6 of the general complications in the lateral group. The number of biomechanical complications (migration, cut-out, varus) was 9 in the supine group and 11 in the lateral group. The number of complications were 36, 19 of 36 in the supine group and 17 of 36 in the lateral group (p=0.296). X-rays of patients with removal and migration are shown in Figure 2.

The mean TAD was 34.9 mm in patients with removal complications. The mean TAD was 10.3 mm in three patients with medial migration. Helical blade placing was in the safe zone in 3 patients and outside the safe zone in 7 patients. Varus deformity was assigned in 5 of 7 patients with removal. All complications were treated in the revision process according to etiological factors. One patient underwent surgical procedure as arthroplasty after a failed revision surgery.

Tip-apex distance, collo-diaphyseal angle, and reduction range were individually compared for stable and unstable fractures. A statistically significant difference was observed only for the reduction range values (p<0.05). The mean of the reduction range was significantly higher in the unstable group (5.7 mm) than in the stable group (1.9 mm) (p<0.01). Both groups were

treated equally post-operatively as to rehabilitation/physical therapy protocols, aside from ambulation.

Discussion

This study showed that one of both positions did not predominate over the other to reduce rates and surgical complications. The advantages of the supine position can be listed as reduced operation duration, easy application in patients with contra-lateral extremity fracture, technical ease in patients with planned surgery during the same session for contra-lateral extremity, and easy interpretation of the fluoroscopy image due to its compliance with the patient's position. The advantages of the lateral position include a more comfortable incision and exposure, applicability in obese patients, and a contribution to the reduction due to adduction posture. Therefore, its advantages are its applicability in obese patients and contribution to the reduction due to adduction posture.

Herman and colleagues established the localization of lag screws in the safe region in addition to the tip-apex distance, and this was measured on the antero-posterior X-ray, which was among the most important criteria to evaluate the stability in cases of intertrochanteric fractures fixed by the proximal femoral nail [8]. A line is drawn from the midpoint of the neck to the center of the femur head, then a line is drawn to join the femoral head and neck, and the safe zone is accepted as two-third from the inferior part of this line (Figure 3). Herman established that the lag screw was not in a safe zone in the majority of patients developing post-operative mechanical complications [7]. In this study, the term Herman's safe zone, calculated by linear lines, was used. In this study, the helical blade was placed out of the safe zone in 5 of 7 patients with removal complications. The localization of the helical blade placing was not affected by the supine or the lateral operation position. Herman also determined that the lag screw was out of the safe zone in 11 of 15 patients with cut-out [7].

Several studies indicated that the need for a TAD less than 25 mm is the rule only for Dynamic Hip Screw (DHS) and that TAD should be between 20 and 30 mm in PFN-A cases to prevent medial migration and cut-out [9]. However, TAD not exceeding the range of 15 to 45 mm, did not primarily affect the cut-out [10]. According to the common point of view in the literature, TAD affects stability. In this study, TAD was observed more than 30 mm in patients with removal and less than 15 mm in patients with immigration. Wrong position of the hip screw or its improper extension may result in the removal of the screw from the femur head (cut-out) [11,12]. The reported rate was up to 10% for screw removal [13,14]. The removal rate of 3.6% and 2% were in the supine position on a traction table. In another study, in which the operation position was not reported, the removal rate was 4.7% [11, 15, 16]. In this study, removal was observed in 7 patients (4.4%). Among them, 4 cases were in the lateral group and 3 were in the supine group. The tip-apex distance was over 25 mm in all of these patients, and varus was presented in 5 patients.

Varus deformity is the most important complication increasing the removal. In a study, the mean collodiaphyseal angle was 125.6˚ in patients with removal development [17]. In our study, the mean collodiaphyseal angle was 126.3˚ in 7 with removal development. In all patients, varus deformity was detected using X-rays obtained in the second and third months.

Xue et al established the mean operation time using a traction table for the lateral position group as 50.6 minutes, and the supine position group as 65.67 minutes. Turgut et al determined the mean operation duration as 57.2 minutes and 76.50 minutes in the lateral position groups. Pahlanvanhosseini et al demonstrated the mean operation duration as 79.50 minutes and 35 minutes in the supine position group using the traction table. In studies comparing PFN-A patients in the supine and lateral position on a traction table, no difference was found in complications and all studies were consistent with the literature [16, 18, 19-22]. In this study, we detected the mean operation time as 60.73±24.20 minutes (55.63-65.83) in the lateral position group with 89 patients and 61.12±21.63 minutes (56.00-66.24) in the supine position group with 71 patients. There was no statistical difference in the mean operation duration of both groups ($p>0.914$).

Handicaps for both positions are the need for technical experience to interpret the image due to contralateral leg superposition on the fluoroscopy image, as well as the need for continuous manual traction during the whole operation. The advantages of both positions are the unnecessity of the traction table, elimination of complications due to the traction table, and even reduced operation duration.

This research, however, has several limitations: 1) the number of cases was relatively small compared to other similar studies, 2) more emphasis could be placed on a question-based framework, 3) a prospective study could have been chosen, rather than a retrospective study, 4) more emphasis needed, based on complications and outcomes of the study groups, 5) another limitation point was the number of surgeons as six senior orthopedists.

Conclusion

We conclude that a full lateral image can be obtained, appropriate reduction can be achieved and successful PFN-A fixation can be performed by continuous manual traction in the lateral and supine positions without using a traction table. There is no difference between the two positions in terms of results and complications. If the traction table was not accessible, this surgery can be performed in the lateral and supine positions with a radio-lucent table.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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